

block) (trade name "Pluronic F127"). At low temperature, the two POE segments at the ends of the triblock systems are water-soluble, and given the low molecular mass of the copolymer, the solutions are relatively only slightly viscous up to a high concentration. By raising the temperature to around 15-25°C, the central POP central segment becomes more hydrophobic, and these polymers combine to constitute inside the medium an organized three-dimensional network having a predetermined structure, which confers the appearance and the consistency of a gel on the medium. Unfortunately, this mechanism exhibits several disadvantages for electrophoresis. On the one hand, it only gives rise to a gel state endowed with good electrophoretic separation properties at high polymer concentrations, greater than 15 g/100 ml or even 20 g/100 ml, which leads to high friction and to long migration times. Moreover, the dependence of the properties as a function of the rate of change in temperature makes the reproducibility of the results unpredictable. Finally, the products proposed in WO 98/10274 exhibit a low viscosity either below room temperature or above room temperature, and exhibit a gel state which is advantageous for electrophoretic separation in the region of room temperature (25°C), which is not advantageous either for conveniently filling the capillaries, or for applications such as DNA sequencing.

Triblock copolymers having the same structure, with different molecular masses, give rise to comparable physical properties and to performance features in terms of separation which are comparable to or less than F127. Also described in WO 98/10274 is a POB₁₂-POE₂₆₀-POB₁₂-type polymer, where POB means polyoxybutylene. Unlike the preceding polymers, these polymers give rise to a state which is not very viscous at a temperature greater than room temperature, and to

gelling by lowering of the temperature to the region of room temperature.

It should be noted that other polymers exist which may exhibit a thermoviscosity-promoting or thermothickening character in water. Thermoviscosity-promoting polymers are described in Patent Application EP 583 814 which contain, on the one hand, hydrophilic portions of the prepolymer or macromonomer chain type which do not exhibit an LCST in a useful temperature range, and, on the other hand, hydrophilic portions of the prepolymer or macromonomer chain type which exhibit an LCST in the said useful temperature range. However, polymers of this type cannot be used with good performance features as separation medium for electrophoresis for several reasons. On the one hand, they only exert their thermoviscosity-promoting effect in the presence of a relatively large quantity of salt in the solution, between of the order of 0.4 M and several M. This property is highly crippling for electrophoresis, because the use of highly saline solutions leads to heating of the solution and prevents the use of strong electric fields. The separations in highly saline media are therefore slow and of low resolution. Moreover, they exhibit an electrically charged skeleton: if it is desired to use them as electrophoretic separation medium, the polymers constituting the matrix risk being set in motion, or giving rise to electroendosmosis, disrupting the separation which it is desired to obtain through interaction between the analytes and fixed obstacles. Thirdly, these media are intended to give rise to thermoviscosification or to maintain a roughly constant viscosity in a unique and relatively broad temperature range covering the LCST of the said hydrophilic portions with LCST. However, it would be particularly advantageous, for electrophoresis, to have two clearly distinct useful temperature ranges, one for injecting the separation medium into the capillary, and the other for the actual electrophoretic separation,

the said separation being carried out while the medium is maintained at a roughly constant temperature.

In fact, most synthetic media proposed up until now as
5 being capable of giving rise to a thermoviscosifying
effect have a charged skeleton (L'Alloret et al.,
Colloid. Polym. Sci., 273, 1163-1173 (1995), Hordet,
Polymer preprints, 34, 972-973 (1993), Hordet et al.,
Polymer, 38, 2535-2547 (1997)). Indeed, a customary way
10 of conferring thermoviscosifying properties on a
polymer consists in constructing a molecule having
chain portions which are hydrophilic at any temperature
and which help to maintain the molecule in solution,
and chain portions with LCST which lead, through a rise
15 in temperature, to an attractive interaction between
chains, which are responsible for the viscosification.
To obtain good viscosification, it would be desirable
to multiply the proportion of chains with LCST and
their force of interaction, but such an increase also
20 tends to induce a macroscopic phase separation which,
by contrast, reduces the viscosity. The presence of
electrical charges on the skeleton helps to prevent the
macroscopic phase separation through an effect of
entropy of the counter-ions or of electrostatic
25 repulsion, and therefore makes it possible to cause
entry into the polymer composition of a quantity of
portions with LCST which is sufficient to give
viscosification, while preventing macroscopic phase
separation. It can therefore be seen that it is
30 particularly difficult to constitute thermoviscosifying
media based on polymers with a neutral hydrophilic
skeleton. A few examples of such media have been
described in Vos et al., Polymer, 35, 2644 (1994), but
they only give rise to thermoviscosification in the
35 presence of a high salt level and at temperatures of
more than 80°C, which also makes them unusable for most
of the applications which may be envisaged as a
separating matrix, and in particular for
electrophoresis.